



The Cobweb Theory and the Semiconductor Capital Expenditure Cycle

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Introduction

In this article Intermede considers the theoretical economic underpinnings of the semiconductor industry, specifically the DRAM market ("Dynamic Random Access Memory"). This market has long been characterized by dramatic swings between shortage and oversupply, with periods of exceptional profitability followed by painful downturns. While each cycle appears unique on the surface, many of the industry's fluctuations can be explained through a classical economic concept known as the cobweb theory.

Originally developed to describe agricultural markets, the cobweb theory provides a useful framework for understanding why industries with long production lead times and delayed supply responses repeatedly experience boom-and-bust cycles.

Intermede tends to invest only very selectively in these kinds of industries, which like many commodity markets rely on market timing factors that are difficult to anchor in long-term conviction about fundamentals. This is true of our exposure to DRAM memory providers in recent periods where, although we acknowledge the strength of current industry drivers and have had some exposure as a result, we still believe that inherent and sometimes violent cyclicity remains a dominant feature which prevents us from building larger positions.

The Cobweb Theory - Background

The cobweb theory explains how producers make output decisions based on current prices, even though the additional supply will not reach the market until much later. If prices are unusually high because demand temporarily exceeds supply, firms interpret those prices as a signal to increase production. However, because production requires time to expand, the new supply often arrives after demand has normalized. The resulting excess production depresses prices, causing firms to reduce

investment. This reduction eventually leads to shortages once demand recovers, restarting the cycle. Rather than converging toward equilibrium, markets with long investment lags can oscillate between periods of scarcity and glut.

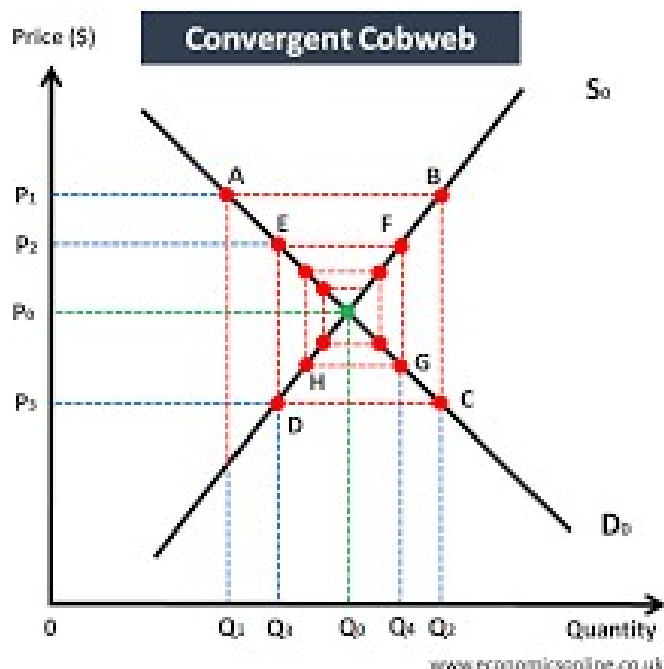
There are two main cobweb diagrams that illustrate various industry dynamics. In the instances where the supply is more inelastic than demand, a so-called convergent or stable cobweb emerges, whereby equilibrium is restored over time. This is largely due to the availability of substitute goods in the supply chain that allow for consumers or producers to change their input mix enough to affect price convergence of supply with demand.

In the instances where it is demand that is more inelastic than supply however, a divergent or unstable cobweb emerges, where each cycle pushes supply and demand further away from equilibrium. It is this latter case that is more relevant for the semi-conductor industry, as DRAM is essential to semiconductor production and no substitutes exist, while technological innovation creates greater supply elasticity.

In the charts below, we can see the cobweb model's micro-economic patterns visually. In the convergent cobweb model, changes to the market initially starts at **Point A**, where the price (P_1) is well above the equilibrium price. The high price signals producers to increase output, but because production takes time, the additional supply reaches the market in the next period. This increased production results in **Point B** on the supply curve and, when matched with the demand curve, causes the price to fall sharply to **Point C** (P_3). The low price then discourages production, leading producers to reduce output in the following period. The resulting lower quantity moves the market to **Point D**, where the reduced supply pushes prices back up to **Point E** (P_2).

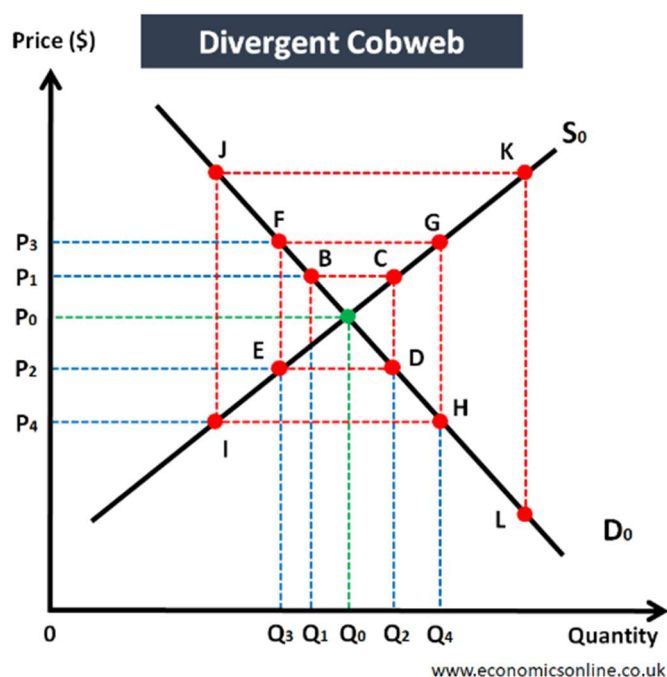
This process repeats over successive production cycles. Each period's price determines the next period's output, and each resulting quantity determines the next market-clearing price. Because the supply curve is steeper than the demand curve in a convergent cobweb, each successive adjustment

is smaller than the previous one. The sequence of points (A → B → C → D → E → F → G → H) spirals inward until both price and quantity converge on the long-run competitive equilibrium at the center of the diagram. At that point, producers' output decisions exactly match market demand, eliminating further oscillations.



previous period's price because production requires time. However, in this case, the supply response is more elastic than the demand response, causing each adjustment to overshoot the equilibrium by an increasingly larger amount. Rather than converging toward a stable market-clearing price, the market experiences widening price swings over successive production cycles.

In the diagram above, the market begins at the equilibrium point. Suppose prices increase unexpectedly to **Point B** at P_1 , encouraging producers to expand production. Because of production lags, the higher output reaches the market in the following period at **Point C** on the supply curve. The resulting excess supply forces the market price down to **Point D**, where prices fall well below equilibrium. Producers respond by sharply reducing future production, but this reduction is not realized until the next production cycle. The lower output shifts the market to **Point E**, creating a shortage that drives prices up again to **Point F**, this time exceeding the previous price peak. The cycle then repeats as higher prices stimulate even greater production, leading to **Point G**, followed by another, even larger price collapse to **Point H**. Each oscillation becomes larger than the previous one, causing the market to spiral away from equilibrium rather than toward it.



The reason equilibrium is never achieved is that producers consistently overreact to the previous period's price signal. When prices are high, investment and production increase by more than demand ultimately requires. When prices collapse, production is cut back too aggressively, creating future shortages. Because supply responds more strongly than demand, each production decision amplifies the imbalance rather than correcting it. The combination of delayed production decisions and highly elastic supply means that market participants continually "chase" yesterday's prices instead of responding to current market conditions.

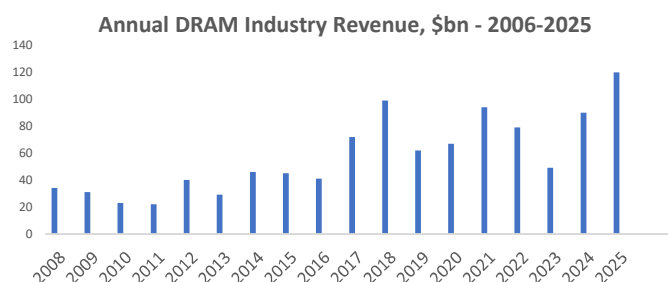
A **divergent cobweb** illustrates a market in which prices and quantities move progressively farther away from equilibrium following an initial disturbance. Like the convergent cobweb model, producers base their production decisions on the

DRAMs and Cobweb Theory

The DRAM industry represents one of the purest modern examples of the cobweb theory in action. Constructing semiconductor fabrication facilities requires tens of billions of dollars in capital expenditures, while bringing new manufacturing capacity online often takes several years. Once facilities are operational, producers have strong incentives to continue manufacturing even during periods of weak pricing because variable production costs remain well below the enormous fixed costs already incurred. As a result, supply tends to respond slowly and often excessively to changes in market conditions.

Historical DRAM cycles demonstrate this pattern repeatedly. During periods of rising memory demand—whether driven by personal computers in the 1990s, smartphones in the 2010s, or cloud computing more recently—prices and margins have expanded rapidly. Producers respond by announcing large capital expenditure programs designed to capture future growth. By the time the additional wafer capacity enters production, however, demand growth has frequently slowed, inventories have accumulated, and prices have collapsed. Profit margins deteriorate sharply until reduced investment and production discipline eventually restore balance to the market.

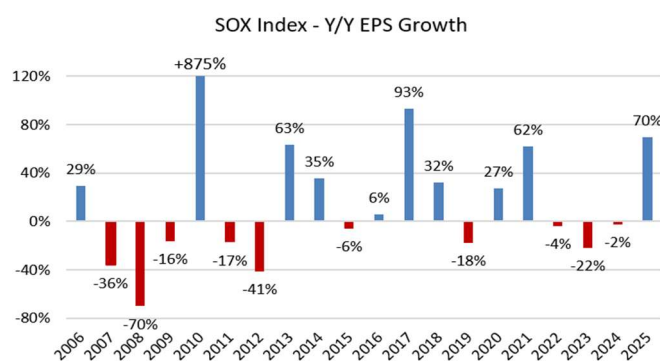
We can see this pattern in terms of the overall revenue trend for the industry for the past twenty years. We detail the year-on-year evolution of DRAM industry revenue in the chart below. As the chart shows, significant revenue growth over time comes with severe cyclical contractions, which have often led to industry consolidation and competitors disappearing due to fragile economics.



Disclosure: AI-assisted research support was used in preparing the above chart. All content was reviewed and validated against the cited sources including Trendforce, Omdia/HIS and IC Insight.

Another way to track the cyclicity of the DRAM industry is to look at the peaks and troughs in year-on-year earnings growth of the Philadelphia Semiconductor index, often known by the acronym SOX. The SOX is a modified market-capitalisation weighted index tracking leading global semiconductor companies involved in the design, manufacture, and sale of chips, and is widely regarded as a benchmark for the semiconductor industry.

As the chart below shows, strong earnings growth can be followed by abrupt contractions, reflecting the dynamics we have discussed previously.



Source: Bloomberg

Industry consolidation has moderated but not eliminated these cycles. Today, a handful of companies dominate global DRAM production, creating a more rational competitive structure than existed decades ago. Capital discipline has improved, and producers have become more willing to manage supply growth. The best current example of this is probably the successful growth of SK Hynix, a company initially formed because of the distressed financial situation of two legacy South Korean chip manufacturers (Hyundai Electronics and LG Semiconductors.) Nevertheless, the fundamental economics remain unchanged. Long construction timelines, enormous fixed investments, and uncertainty surrounding future demand continue to create the delayed supply responses that lie at the heart of the cobweb model.

AI's impact on DRAM market in 2026 and beyond – cobwebs all over again ?

At Intermede, we recognize that the current AI-driven environment is in all probability of a different magnitude to previous ones. The proliferation of large language models, accelerated computing, and AI inference workloads has materially increased the amount of memory required per server and per workload, shifting the entire demand curve to the right. This reflects a sustained increase in underlying demand at every price point rather than a temporary response to higher or lower prices, making the current cycle structurally distinct from prior memory upcycles.

In order to meet this demand shift, the DRAM industry will have to once again, as it has in the past, shift the supply curve to the right through process technology innovation. Successive manufacturing nodes have delivered profound increases in bit output and effective capacity, enabling the industry to support growing demand while driving significant cost reductions. Future innovations could also alter the demand equation. Improvements in model efficiency, compression techniques, or architectural changes that reduce memory intensity could temper future DRAM requirements, while alternative memory technologies such as SRAM or other emerging architectures could eventually substitute for portions of DRAM demand in specific applications.

The fluid nature of demand and supply dynamics is typical for the DRAM industry, where stable equilibrium pricing over the long term has been elusive– more of a divergent cobweb, as we described it previously. The combination of recurring supply expansion and long-term price erosion has defined the industry's economics, even as periodic imbalances produced cyclical volatility.

The current AI driven semiconductor capital expenditure cycle, although its scale is unusually large, reflects in our view many of these historical characteristics. Massive investments are being directed toward advanced logic foundries, high-

bandwidth memory, advanced packaging, and artificial intelligence infrastructure. Governments are also encouraging domestic semiconductor manufacturing through industrial policies and subsidies, reinforcing the incentive to expand production. These investments are occurring against a backdrop of extraordinary optimism surrounding artificial intelligence, leading many market participants to project sustained demand growth for years to come.

While the magnitude of today's capital spending is exceptional, however, the underlying dynamics are not unprecedented. Previous semiconductor booms have been driven by similarly transformative technologies, including personal computers, internet infrastructure, smartphones, and cloud computing. Each technological revolution generated compelling narratives suggesting that demand growth would permanently outpace historical experience. In every instance, producers responded with aggressive investment, supply eventually caught up, and pricing pressure followed. Although the technologies differed, the investment behavior remained remarkably consistent.

In the final analysis, however, recognizing the strength of demand does not invalidate the economics of delayed supply adjustment. Even if AI demand continues expanding rapidly, semiconductor manufacturers around the world are simultaneously investing unprecedented sums to increase productive capacity. History suggests that forecasting demand is inherently difficult, while supply expansions often prove larger than anticipated because numerous firms respond to the same market signals. The cobweb mechanism does not require demand to collapse; it merely requires supply growth to temporarily exceed demand growth, producing downward pressure on prices and returns.

Conclusion

Intermede believes that the central lesson is one of maintaining humility given historical precedent rather than making bold predictions. Every semiconductor cycle arrives accompanied by persuasive arguments explaining why "this time is different." Sometimes those arguments contain substantial truth, as technological progress genuinely transforms markets. Whilst the current semiconductor capital expenditure cycle may ultimately prove longer, larger, and more profitable than previous ones, the economic forces underlying the cobweb theory remain remarkably persistent because they arise from the timing of investment decisions rather than from the specific technology involved. History suggests that the semiconductor industry changes rapidly, but the economic cycle governing its investment behavior changes far more slowly.

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